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mHealth Risk Screening in Urban Primary Care

Martha Rose Staeheli, PhD

University of Connecticut, 2015

Background: Urban, underserved populations experience considerable disparities in the screening, prevention, and treatment of chronic disease, including behavioral health disorders. Screening patients for such problems is widely recommended, yet is challenging to do in a brief primary care encounter, particularly for this complex patient population. Electronic risk screening provides one method of eliminating disparities in the identification of risks, while limiting burden on providers.

Objectives: 1) Screening data were compared to EHR data to assess differences in the prevalence of 12 risk factors and clustering of risks; 2) Patients screening positive for behavioral health problems were followed to determine rates of follow-up care, and the rate of newly identified cases in the intervention group; and 3) Successes and challenges in the implementation process were reviewed.

Design: A quasi-experimental design was used to assess prevalence rates of 12 health risks using an electronic tablet-based screening questionnaire.

Sample: Intervention (n=473) and control (n=260) patients were selected from two urban, safety net primary care practices in Connecticut, the majority of whom were non-white and using public insurances.

Results: There was a statistically significant increase in the identified prevalence rates of health risks in the intervention group compared with the control, but most patients had more than one medical risk. For behavioral health disorders in one clinic, follow up rates were statistically significantly higher in the intervention group

relative to controls, but were low overall. While the risk screening intervention was largely successful, challenges included: integration of technological environments, limited clinical resources, and barriers in clinic workflow.

Conclusions: This tablet-based electronic screening tool identified higher rates of disorders than have been previously reported for this population. Electronic risk screening using patient-reported outcome measures offers an efficient approach to improving the identification of behavioral health problems, improving rates of follow-up care, and establishing population public health surveillance. Study-based recommendations are made for the successful future implementation of mHealth screening, including: integration of technological systems, establishment of a critical care pathways, inclusion of all levels of staff on workflow process development, identification of a project champion, and development of standing orders to improve follow up.

mHealth Risk Screening in Urban Primary Care

Martha Rose Staeheli

B.A., Oberlin College, 1998

A Dissertation

Submitted in Partial Fulfillment of the

Requirements for the Degree of

Doctor of Philosophy

at the

University of Connecticut

2015

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APPROVAL PAGE

Doctor of Philosophy Dissertation

mHealth Risk Screening in Urban Primary Care

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CHAPTER ONE: Introduction

Racial, ethnic, and socioeconomic disparities in primary healthcare access and outcomes are well documented, particularly in urban populations, and are a growing focus of healthcare reform initiatives like the Affordable Care Act (DHHS, 2015). Health disparities are due to a number of complex systemic and psychosocial issues, including healthcare access, insurance and financial issues, the number and complexity of medical issues including chronic diseases, provider cultural competence, provider biases, and patient adherence (AHRQ, 2008; AHRQ, 2015a; CDC, 2013).

To address some of these concerns, the principal agenda for improving the health of the American people, *Healthy People 2020*, has three overarching goals: to improve the quality and length of life through prevention and promotion of healthy behaviors, to create healthy environments, and to achieve health equity in underserved communities (DHHS, 2010). These goals are echoed in *Achieving the Promise* (New Freedom Commission, 2003), which supports the integration of behavioral health care into primary care to promote health and reduce disparities. Improved behavioral health treatment is critical to addressing racial and ethnic disparities in health, as behavioral health disorders may be both more prevalent and less recognized and treated in these communities, and are often co-morbid with serious physical health concerns ((Surgeon General, 1999; Surgeon General, 2001; Larson, Belue, Schlundt, & McClellan, 2006; Yamada & Brekke, 2008).

Primary Care in the Safety Net

In the US, primary care remains the best, and sometimes only, gateway to treatment for a variety of complex medical, behavioral health and psychosocial

issues. Although the passage of the Affordable Care Act (ACA) has ensured that 90% of Americans now have health insurance, best estimates indicate that around 24% of people in the US still do not have a specific and consistent source of primary care (Kaiser Family Foundation, 2015; DHHS, 2010). Those who do not have primary care access or insurance are disproportionately non-White, poor, recent immigrants, elderly, or more likely to have chronic diseases or disabilities, and are often living in Medically Underserved Areas or classified as vulnerable populations (AJMC, 2006; HRSA, undated).

Moreover, disparities data indicate that some health care disparities are increasing, rather than decreasing, which is an alarming finding given the degree of healthcare reform and current and projected growth rates for many of these population groups (AHRQ, 2008; AHRQ, 2015a; ADA, 2015). This is particularly true in the area of chronic disease identification and treatment (AHRQ, 2015a; CDC, 2013). While half of all Americans burdened by chronic disease, and a quarter with more than one chronic condition (Ward, Schiller, & Goodman, 2014), the rate of chronic disease varies greatly by race; 51% of Hispanics and 46% of African Americans have a chronic disease, compared with 23% of Whites (AHRQ, 2015a). The management and treatment of these chronic diseases accounts for over three quarters of Medicare spending and occurs mainly in a primary care setting (CMMS, 2012). Given the magnitude of this issue, preventing and treating these conditions are among the greatest and most costly challenges facing primary care (Grossman, Legedza, & Wee, 2008; Paul et al., 2013; Ward, Schiller, & Goodman, 2014).

In addition to a higher prevalence of chronic disease, patients in urban safety net settings are at even greater risk for death and disability as a result of these diseases (AHRQ, 2015a; CDC, 2013; NACHC, 2009). Recent studies indicate that

African Americans and Hispanics have higher age-adjusted rates of mortality from cardiovascular disease and hypertension than do Whites (AHRQ, 2008; Peterson, Shaw, & DeLong, 1997) and lower screening rates and higher death rates from HIV/AIDS and colorectal, prostate, cervical and breast cancers (AHRQ, 2015a; L. Anderson et al., 2003; Bach, Pham, Schrag, Tate, & Hargraves, 2004; Shavers & Brown, 2002). Non-White Hispanic and African American populations are at greater risk for diabetes (around 13%) compared with Whites (7.6%), and are considerably more likely to experience complications of diabetes, including lower limb amputations, retinopathy, kidney failure, and death (ADA, 2015; Cefalu & Hill Golden, 2015; CDC, 2014). Dental caries, the most prevalent chronic health condition among American children (DHHS, 2000), disproportionately afflict minorities and those whose caregivers are of low socioeconomic status (Edelstein, 2002; Montero, Douglass, & Mathieu, 2003; Shiboski, Gansky, Ramos-Gomez, & et al., 2003; Tang, Altman, Robertson, & et al., 1997).

Patients in urban safety net settings are also more likely to receive a poorer quality of care. Comparatively few physicians provide care in African American communities and those who work in clinics serving greater than 30% minority patients have less access to supplies, specialists, examination rooms and diagnostic equipment (Bach et al., 2004). Racial minorities are, on average, referred less often to specialty clinicians for follow up than are Whites, even when socioeconomic status, insurance status and health status are held statistically constant (L. Anderson, Scrimshaw, Fullilove, Fielding, & Normand, 2003). And while these populations receive less necessary medical care, they also receive more unnecessary health procedures like amputations, orchiectomies, and avoidable hospitalizations (Fiscella, Franks, Gold, & Clancy, 2000; Gawande, 2015).

A major barrier to the provision of quality care for poor, minority populations is the number and complexity of medical issues such patients present, coupled with the limited duration of a typical patient encounter with a primary care physician and limited provider staffing (Fiscella & Epstein, 2008; NACHC, 2009). Patients in these clinics are more likely to be depressed, have chronic pain, substance abuse and more medically and psychosocially complex lives (Bach, Cramer, Warren, & Begg, 1999; Bach et al., 2004; Varkey et al., 2009). Even when medical needs are identified and treated appropriately by clinicians, poorer or traditionally marginalized patients have additional barriers to receiving effective care due to lack of cultural sensitivity, more toxic environmental exposures, lack of preventive care, cost of prescriptions, inability to take time off from work and finding appropriate transportation to primary care and specialty visits, as well as meeting Medicaid, Medicare and ACA insurance deductibles (AHRQ, 2008; AHRQ, 2015a; L. Anderson et al., 2003; Betancourt, Carrillo, Green, & Maina, 2004). Often these patients are then discharged from care for non-adherence to treatment regimens or because the services they require are not reimbursable at a high enough rate (Kleinsinger, 2010). These barriers to care can give providers the impression that patients are “non-compliant” or “difficult to treat,” even when patients are motivated to participate in their own medical care (Kleinsinger, 2010; Roter et al., 1998).

The Integration of Behavioral Health in Urban Primary Care

One major barrier to better health for medically underserved patients is the estimated 50% of behavioral health needs that remain undiagnosed (New Freedom Commission, 2003; DHHS, 2001; WHO, 2008). For much of the US, primary care settings have become the first and only entryway for addressing the needs of the one in four adults with a diagnosable behavioral health condition (Surgeon General,

1999; New Freedom Commission, 2003). This is particularly true in urban clinics that disproportionately serve racial and ethnic minorities, the poor, immigrants, and the chronically ill (AHRQ, 2003; Grossman et al., 2008; Sandoval et al., 2010). Because poor and urban populations also have more complex and serious medical needs, behavioral health disorders can be perceived as ancillary to or superseded by emergency conditions such as diabetes, hypertension, and cancer treatment (Gift, Strauss, Ritzler, & Kokes, 1988; Haughey, Calderon, Torres, Nazario, & Bijur, 2005; Larson et al., 2006). However, when these conditions are not recognized and treated in marginalized populations, they have more devastating effects (compared with more affluent groups) on co-morbid medical conditions, overall family health, employment and education, and morbidity (Birnbaum et al., 2010; Braveman & Gruskin, 2003; Cameron, Lawton, & Reid, 2011; Downey, Zun, & Gonzales, 2009; McGibbon, Etowa, & McPherson, 2008; Pence, O'Donnell, & Gaynes, 2012).

Although the Epidemiologic Catchment Area Study suggests that many behavioral health disorders may be similarly prevalent across racial and ethnic groups, these disorders are not equally identified and treated in Hispanics and African Americans versus Whites (see Simpson, Krishnan, Kunik, & Ruiz, 2007 for a review). For example, 88% of African Americans living in the inner city have had exposure to severe trauma, compared with around 39% in the general population (Gillespie et al., 2009; Liebschutz et al., 2007). As a result, from 23-46% of patients in community health center clinics are found to have post traumatic stress disorder (PTSD) compared with 7.8% in the general population, although 90% of PTSD in urban health settings is unrecognized by providers, which accounts for the range in estimates of its prevalence (Gillespie et al., 2009; Kessler, Mickelson, & Williams,

1999; Kessler & Wang, 2008; Liebschutz et al., 2007; Schwartz, Bradley, Sexton, Sherry, & Ressler, 2005).

This type of disparity in risk exposure and treatment is also seen in prevalence of alcohol abuse and its treatment. Native Americans and Whites are at the greatest risk of alcohol dependence (SAMHSA, 2014), but once dependence occurs, African Americans and Hispanics are more likely to have recurrent and persistent dependency issues (Chartier & Caetano, 2010; Nosek, Hughes, & Robinson-Whelen, 2008) and are less likely to have access to a physician for treatment (SAMHSA, 2007). Ethnic minorities are also more likely to report more severe social and medical consequences from drinking (Mulia, Ye, Greenfield, & Zeng, 2009). Several studies have identified a greater density of alcohol outlets such as bars and liquor stores in neighborhoods with high numbers of minorities, which is associated with higher levels of alcohol dependence and alcohol related violence (Chartier & Caetano, 2010; Young, Meryn, & Treadwell, 2008).

In urban and underserved populations, behavioral health disorders like alcohol abuse and PTSD are often exacerbated by other psychosocial risks and are concomitant with other illnesses like depression (Christensen et al., 2005; Paul et al., 2013; Pence et al., 2012; Rayburn et al., 2005). Depression presents one of the greatest challenges to the US medical system. Recent studies estimate that the economic burden of depression exceeds 210.5 billion dollars annually, and the impact of depression on the management and course of chronic diseases such as diabetes and heart disease is profound (Greenberg, Fournier, Sisitsky, Pike, & Kessler, 2015).

While the rate of depression is around 9.5% in the general population, rates closer to around 19% have been found in poor urban clinics, with higher rates for

Hispanic patients (22.3%) (Olfson et al., 1997; Olfson et al., 2000). However, 30-66% of people in primary care centers who are depressed or anxious remain undiagnosed, compared to 10% in Whites, particularly if they are elderly, African American or Medicaid recipients (Harman, Schulberg, Mulsant, & Reynolds, 2001). African Americans are one third as likely to discuss depression with their primary care doctors compared to Whites, and only two thirds of African Americans who express emotional distress are diagnosed as depressed, compared to 90% of White patients (Ghods et al., 2008). The race of the physician, not that of the patient, determines whether a depression diagnosis would result when the physician is presented with a patient's depressive symptoms; White physicians diagnose depression in African American patients more often than do African American physicians (McKinlay, Lin, Freund, & Moskowitz, 2002). This is complicated by the fact that African Americans are more likely to be treated by African American physicians than are Whites (Laveist & Nuru-Jeter, 2002).

Although around 50-90% of people with depression recover, rates of treatment for and recovery from depression are notably lower for people in medical safety net populations (Surgeon General, 2000). In the general population, one third of all people who are depressed never get treatment for this condition after being diagnosed, but for those who are non-White, between 50 and 70% do not receive mental health treatment after a depression diagnosis (Surgeon General, 2001; AHRQ, 2015a; Kessler et al., 1999; Kessler & Wang, 2008). In fact, even for those low-income primary care patients who were identified as having major depression, 62% still met criteria for depression after four years, compared with around 20% for Whites, reporting more visits to EDs and worse health and functioning, affecting

families, employment, and global health outcomes (Birnbaum et al., 2010; Watkins et al., 2009).

Given the state of many primary care centers serving poor urban communities, there are often fewer referral resources for counseling, psychiatric consult, or other out-patient services, which is partly responsible for the low rate of treatment (Cabassa & Hansen, 2007; Sartorius et al., 2007; Thomas, Eberly, Smith, Neaton, & Stamler, 2005; Zayas, McKee, & Jankowski, 2004). If behavioral health symptoms are complicated by substance abuse or a serious mental illness, patients may bypass community primary care services altogether, which may partly account for the increase in this population's use of emergency department services and likelihood of imprisonment (Fogarty, Sharma, Chetty, & Culpepper, 2008; Osher, D'Amora, Plotkin, Jarrett, & Eggleston, 2012; Varkey et al., 2009).

Prevention and Screening

Preventive care, including screening, represents a key strategy in addressing healthcare disparities for urban, underserved populations, although these patients remain far behind in their access to and use of prevention services (Fiscella, Holt, Meldrum, & Franks, 2006; Fiscella & Holt, 2007; NACHC, 2009; Partnership for Prevention, 2007). One approach to improving the identification and treatment of common, under-recognized mental and physical health conditions is to implement systematic screening procedures (or processes). The majority of screening initiatives have been implemented to identify single diseases, like colorectal cancers, cardiovascular disease or substance abuse (Aseltine, 2010; Bhat & East, 2015; Davila, Rajan, & Baron, 2006; Emmons et al., 2009; Murff, Peterson, Greevy, Shrubsole, & Zheng, 2007; Thomas et al., 2005). Comprehensive screening remains a challenge, despite its potential benefits (Southern et al., 2014). The US

Preventive Services Task Force (USPSTF) recommends screening protocols for 53 medical conditions (AHRQ, 2015b) the completion of which, along with other preventive services, would require more than 7 additional hours a day per provider in primary care (Shires et al., 2012; Yarnall, Pollak, Østbye, Krause, & Michener, 2003). These challenges are particularly critical in clinics serving poor and minority patients, where resources are especially scarce and the incidence of such conditions is particularly high (Fiscella & Holt, 2007; Fiscella & Epstein, 2008; Partnership for Prevention, 2007). As a result, screening often drops on the priority list of tasks that must be accomplished during a short visit, and nursing staff bears more of the burden of screening administration and delivery of preventive care, and care coordination (Institute of Medicine, 2010; D. Anderson, St. Hilaire, & Flinter, 2012; NACNEP, 2012).

However, primary care may be the only opportunity for patients in safety net settings to have access to screening, identification and treatment for certain types of cancer, obesity, diabetes, and HIV and other chronic diseases. As the first step in prevention, screening for chronic conditions is associated with an increase in patients' health-promoting behaviors and health beliefs (Bankhead et al., 2003; Rasmussen et al., 2007). Screening patients for illness and linking that screening to appointments with a provider results in higher life expectancy even years later (Rasmussen et al., 2007). Likewise, screening for risky drinking in both community and clinic settings has been shown to be an effective approach to linking at-risk individuals to treatment and in reducing alcohol consumption (Dupre, Aseltine, Wallenstein, & Jacobs, 2004; Johnson, Kypri, & Attia, 2013; USPSTF, 2009). Similar results have been observed with community and clinic-based screening for depression (Greenfield et al., 1997).

Screening and mHealth

While some screening protocols, like those for cancer, diabetes, or asthma, require diagnostic tests or imaging, some of the greatest chronic disease risks and co-morbid factors require information that must come directly from the patient (Patient Reported Outcomes), relating either to patient symptoms (e.g., feelings of depression or anxiety), behavior (e.g., diet, exercise, smoking, or drinking), or experience (e.g., exposure to violence, poverty) (Deshpande PR, Rajan S, Sudeepthi BL, Abdul Nazir CP, 2011; Higgins & Green, 2011; McKenna, 2011). For these risk and conditions, patient involvement in providing information using structured screening approaches is crucial. mHealth initiatives are emerging tools in the identification and management of chronic and complex illness and can facilitate patient involvement in providing risk information that is responsive to patient experiences and needs, while eliminating issues of provider knowledge and attitudes, and accounting for time and personnel scarcity (Lubetkin, Santana, Tso, & Jia, 2008; Southern et al., 2014). Mobile technologies, like smart phones and wireless devices, are used in environments all over the world to enhance public health by facilitating provider-patient communication, recording health behaviors, delivering education, and increasing adherence to medical and behavioral therapies in a manner that is cost effective and efficient, with high patient and provider acceptance (Anglada-Martinez et al., 2015; Moore, Holaday, Meehan, & Watt, 2015a; WHO, 2015; Kaiser Family Foundation, 2015; Hamine, Gerth-Guyette, Faulx, Green, & Ginsburg, 2015).

An evolving focus of mHealth implementation research is on the facilitation of screening protocols to identify symptoms of single diseases, like cardiovascular disease, bipolar disorder, depression, and high blood pressure (Clifford et al., 2014;

Deneke, Schultz, & Fluent, 2014; McGillicuddy et al., 2013; Nicholas, Larsen, Proudfoot, & Christensen, 2015; Raghu, Praveen, Peiris, Tarassenko, & Clifford, 2015; Surka et al., 2014). In addition to symptom and risk tracking initiatives like these, mHealth tools and other health information technologies can aid clinical decision making by capitalizing on the time the patient spends in the waiting room, allowing providers to prioritize care in the clinical encounter (Anand, Carroll, & Downs, 2012; Fothergill et al., 2013; Smith, Skow, Bodurtha, & Kinra, 2013). This has proven effective in pediatric populations where patients have efficiently provided risk data electronically, including risk behaviors, while waiting for appointments, decreasing burden for clinicians (Anand et al., 2012; Fothergill et al., 2013; Smith et al., 2013). Aside from pediatric patients, the effectiveness of mHealth innovations on improving health outcomes is mixed and highly determined by patient access to and ease with information technology (Anglada-Martinez et al., 2015; Hamine et al., 2015). Though little research has been done with medically underserved populations in the United States, mHealth technologies may have potential to effectively engage, monitor, and assess patients that access and use healthcare in less traditional manners and settings (Hamine et al., 2015; Moore, Holaday, Meehan, & Watt, 2015b; Silva et al., 2015).

Purpose of this Project

This dissertation presents the results of a project funded by the Connecticut Health Foundation under the direction of Robert Aseltine, Ph.D. at UConn Center for Public Health and Health Policy. A computerized risk-screening tool was used to collect self-administered health screening measures in the waiting room prior to a scheduled visit; these data were then scored immediately and summarized in a risk profile that could be accessed by the primary care provider at the time of the clinical

encounter. These screening results were compared to data derived from chart reviews of patients seen prior to the deployment of the screening intervention to (1) establish the rates of unrecognized and undiagnosed health problems in this patient population, (2) determine whether increased recognition of behavioral health problems in the encounter was associated with appropriate treatment and follow-up of identified patients, and (3) describe lessons learned in the implementation of an electronic screening protocol in an urban primary care setting.

CHAPTER TWO: Methods

Study Design

A quasi-experimental design was used to assess usability and effectiveness of an electronic, tablet-based screening questionnaire among adult primary care patients in an urban setting. These tablet data were used to compare identified rates of commonly encountered conditions and needs among patients completing the tablet screening, compared to patients in that same clinic that did not. Two community health center clinics participated in the study. Risk conditions and needs assessed included obesity, smoking, fall risk, osteoporosis risk, sexually transmitted infection (STI) risk, alcohol abuse, depression, post traumatic stress disorder (PTSD), domestic violence, basic needs (risk for homelessness and food insecurity), dental care needs, and need for colonoscopy among adult primary care patients.

Participants

Seven hundred thirty three patients participated in this project. Screening results for 473 patients in the intervention group were compared to a control group of 260 primary care patients who were seen at the same clinics in two weeks prior to the implementation of the risk screening intervention. All participants were 18 years or older and current primary care patients at two urban ambulatory primary care health centers in Connecticut. Demographic characteristics of patients participating in the study are presented in Table 1. The majority of patients were non-White, middle-aged, female, and using public insurance. At both clinics, all patients who had not previously completed the screening questionnaire and presented to the clinic for a physical exam, an urgent care visit, walk-in visit, routine follow up, or well visit were eligible for screening. Patients were not eligible for the study if they spoke a language other than English or Spanish, had a disability that prevented completion of

the screen, were in acute medical distress, or were scheduled for brief encounters such as immunizations, BP or A1C checks, diabetic foot or retinopathy exams.

The screening questionnaire portion of this project was designated by the University of Connecticut Health Center Institutional Review Board to be Quality Improvement work, and thus not subject to IRB review or informed consent processes. Participants were assured that participation in the screening questionnaire was entirely voluntary, was a standard request the clinic made to all primary care patients and that refusal to participate in any part of the project did not affect the services they would receive at present or in the future. All data from the screening questionnaire or from the medical chart/EHR were de-identified and presented only in the aggregate.

Settings

This project was implemented at two primary care clinical sites in Connecticut, both serving patients from medically underserved populations. Clinic A is located in Hartford, CT and funded as a unique university/ community hospital collaboration to address urban Hartford's medical and social service needs. In 2006, Clinic A saw 11,000 patients for primary care visits, all of whom were below the Federal Poverty Line. Half of these patients were Hispanic, 25% were African American, and 25% were White. Only 10% had private health insurance, and a quarter of all patients were uninsured, with the remaining population relying on publicly funded health insurance such as Medicaid and Medicare.

Clinic B in Norwalk, CT offers comprehensive primary medical, dental and behavioral health services for all ages. The center also provides assistance with application for public insurance and other support programs and is the hub for mobile dental services offered throughout Norwalk. In 2010, Clinic B saw 5,000 patients for

primary care visits, 95% of whom were below the Federal Poverty Line. As of 2013, Whites were 20% of the total clinic population, Hispanics were 50%, African Americans were 25%; the remaining 5% were “Other.” A quarter of all patients were uninsured, 8% were self-pay and the remaining population relied on publicly funded health insurance like Medicaid and Medicare.

Procedures

Prior to implementation of the project, all clinic staff members were trained on the need for comprehensive risk screening and preventive care, use of the tablet technology, the risk assessment tools and their interpretation, and collaborated in development of workflow processes. Staff from both clinics, including receptionists, medical assistants (MAs), nurses, physicians, and administrators, were brought together multiple times prior to the implementation of the project to review project goals, to outline a workflow amenable to the clinic and its staff, and to address questions and concerns. All staff members were encouraged to be active participants in designing the screening workflow and to engage in an iterative formative evaluation process throughout the project. Additionally, champions of the risk-screening project were identified at both locations to take ownership of the intervention and the workflow process, and to serve as a contact point for staff questions or concerns.

To begin the screening process, the receptionists, who were trained in all aspects of the project and supervised by project staff, entered patients' medical record numbers into the tablet. Patients then completed the screening questionnaire, in English or Spanish, in the waiting room or in a separate exam room. An audio version using headphones in either language was also available in

the case of low literacy or visual disability. Reception and project staffs were available to address any questions or concerns.

For the intervention group, 473 clinic patients seen between July, 2012 and December, 2013 completed the electronic risk screening questionnaire and their results were compared to a control group of 260 primary care patients who were seen at the same clinics in two weeks prior to the implementation of the risk screening intervention. In Clinic A, 327 patients were screened between July, 2012 and September, 2013. Due to the technological and logistical constraints on data collection, it was not possible to determine the number of eligible patients from which this group was drawn, nor did providers see the results of the screening questionnaire. (Chapter Five reviews deviations from the proposed screening process in more detail).

In Clinic B, 314 clinic patients seen between September and December 2013 were asked by receptionists to complete the electronic risk-screening questionnaire in the waiting room after checking in for their appointment. Screenings were completed with 146 of 314 eligible patients (see Figure 1 for an intervention flow chart). Patients who did not complete the screening were typically seen during periods when the clinic was very busy or when receptionist coverage was limited. At Clinic B, results and recommendations for referral or further follow-up were summarized on the tablet and made available to the clinician. Providers were asked to review screening scores and to act according to their own clinical judgment. All data, scores, and recommendations were kept confidential in a secured database and were treated as part of the patient's medical record.

Screening Instrument

The questionnaire instrument was compiled by the PI (Aseltine) and the project manager (Staehele). The tablet-based screening platform, designed by OpenClinica, LLC. and Dimagi, Inc, allowed self-reporting by patients using a touch-screen Android tablet that supported English and Spanish versions of the instrument, as well as audio versions for patients with low literacy or vision impairment. This instrument incorporated dynamic branch logic to capture detailed information triggered by prior responses where needed from patients (e.g., to navigate between the two tiers of the screening instrument). The first tier of questions included 18 basic demographic and health risk questions – age, race and ethnicity, gender, marital/partner status, global health rating, height, weight, smoking, alcohol use, depression (2 questions), dental risk (2 questions), and financial and housing status (4 questions). Based on patients' responses to these initial questions, a series of follow-up questions were presented in tier 2 to determine patients' risk status. Completion of all screening questions took approximately 5-8 minutes, depending on the number of tier 2 follow up questions. For instance, patients would only be asked to complete the 4-item HITS domestic violence screening instrument at tier 2 if they reported having a spouse/partner in the tier 1 questions. This approach ensured that respondents were only asked to complete questions that were appropriate to their risk profile and resulted in a much more efficient data collection effort.

Screening responses were transmitted through a secure wireless network to a secure server where they were automatically scored and analyzed for recommendations. Results and recommendations were summarized on the tablet. At Clinic B, the results were manually entered into the clinic's electronic health (EHR)

record by a MA prior to the clinical encounter. Due to technical barriers, medical providers did not see the screening results from Clinic A.

Measures

Risk Screening Instrument

The measures and data sources for the intervention and control groups at each clinical site are summarized in Table 2. For the intervention group, the primary outcomes consisted of measured prevalence rates of risk dimensions as obtained through screening results obtained during the target appointment. Where possible, standardized and validated measures in both Spanish and English were used to assess needs and risk of medical condition (Table 3). Screening measures were scored according to rubrics set out by the original authors of the measures, and all measures' scoring resulted in dichotomous variables indicating either the presence or absence of risk.

For health domains in which validated measures were not available (e.g. dental health and basic needs), focus groups of professionals and experts were consulted to generate three questions each that would be indicative of the need for care. All focus groups followed similar established methodologies for conducting focus groups and qualitative data analysis (Kitzinger, 1995; Morgan, 1996; Robinson, 1999). In the resulting screening questions (see Table 3), a positive answer to any one of the three questions would result in a dichotomous positive screening result on the risk dimension.

For the basic needs dimension, two focus groups were convened at a homeless shelter in New Haven, CT and led by an experienced qualitative researcher with expertise in homelessness. The groups' charge was to determine three questions that could be asked in a primary care visit that would indicate pre-

homelessness or risk of food insecurity, resulting in either a referral to social work, case management, or further questions by the PCP. The first focus group was conducted with five professionals working in the outreach and engagement of people who were homeless and in the management of the homeless shelter. The second focus group was conducted with 12 people who were either currently or formerly homeless. Each focus group was 1-2 hours long, notes were taken to record participants' observations, and consensus summaries reached during the course of the group. Potential questions were re-presented to both groups to check for accuracy and to determine final screening questions.

The dental risk questions were determined similarly with two focus groups led by an experience dental researcher. The groups' focus was to determine three questions that could be asked in a primary care visit that would result in a referral to a dentist or dental hygienist. The first focus group consisted of 8 advanced dental students at UConn Health Center. A second group of 3 dental faculty members at UConn Health was similarly convened. Themes from the discussion were summarized and consensus was reached during the course of the groups. Results were then re-presented to both groups to ensure accuracy and both groups agreed upon screening questions.

Data from Medical Records

All medical/EHR records were systematically reviewed according to the process outlined below (1) to determine the presence of the risk/medical problem as captured in the target appointment, (2) to determine the presence of the risk/medical problem at any visit in the 6 months prior to the target appointment, and (2) to document any treatment or follow-up for these problems occurring in the target appointment or in the 6 months prior to the target appointment. Any mention of

these problems in either the problem list or in the progress notes for any appointment occurring in the target appointment or 6 months prior to the target appointment resulted in a positive score for the problem. A patient was considered to have received treatment or follow up for each of these problems if there was a notation that the provider had counseled the patient, scheduled a follow up appointment for the problem, made a referral to another provider, or prescribed medications.

In addition, demographic characteristics for all patients were recorded, including age, gender, race, ethnicity, source of payment, and history of clinic visits.

EHR and Chart Review Procedures

Medical records were reviewed for evidence of recognition or treatment of any of the risk conditions screened for in the intervention, as described above. The project manager and trained research assistants reviewed all records using dual data entry techniques such that a minimum of two reviewers abstracted every chart. EHRs were reviewed for the intervention (n=146) and control groups (n=129) at Clinic B. Paper medical records were reviewed for the control group at Clinic A (n=131). However, given the volume of patients in the intervention group, the complexity of the record retrieval process and the limited staffing resources, it was not possible to collect medical record data for intervention patients at Clinic A.

In accordance with accepted procedures (Gritsiouk, Hegsted, Gardiner, Merriman, & Dean Gubler, 2013; Liddy, Wiens, & Hogg, 2011; Panacek, 2007; Yawn & Wollan, 2005), cases in the control group were defined as patients having been seen in the clinic in the two weeks prior to the implementation of the screening intervention. Chart review procedure guidelines were developed by the clinical and research teams, and the variables to be included in the review were carefully defined.

Consistent data recording was ensured by a didactic review of five charts by both reviewers, followed by separate review and reconciliation of 10 charts. After each reviewer completed 30 reviews, consistency was again assessed and found to be acceptable, which represented 95% agreement and/or a kappa statistic of .75 or higher (Yawn & Wollan, 2005). The PI, project manager, and the research team adjudicated the small number of coding discrepancies between reviewers.

Prior to resolution of coding discrepancies inter-rater reliabilities were calculated for the entries for each risk factor and ranged between .97 and 1.0, indicating a very high level of reliability. Because identification of and treatment for these disorders were relatively rare, we used the Gwet AC1 (Gwet, 2008) to assess inter-rater agreement. In situations involving low prevalence, traditional measures of reliability, such as Cohen's Kappa, can result in very low, or even negative, values when overall agreement is very high (Byrt, Bishop, & Carlin, 1993; Gwet, 2008).

Analysis

SPSS 22.0 statistical analysis software (SPSS, INC., Chicago, IL) was used to analyze all quantitative data. Statistical approaches are described in the following chapters. Significance tests were two-tailed ($p \leq .05$).

CHAPTER THREE: Use of mHealth Screening Technologies to Identify Risk Prevalence in Urban Primary Care

The purpose of this study was to present overall results from the project and to compare screening results from the intervention group (n=473) to chart review data from the control group (n=260) in both Clinics A and B to: 1) define rates of unrecognized and undiagnosed chronic health conditions and risks, and 2) to determine risks that are associated with one another.

Results

Demographic characteristics of experimental groups from both clinical sites are presented in Table 1. It is important to note that the demographic data for race and payer were limited for the control group at Clinic A, because those data were not always recorded in the paper medical charts. Overall, the intervention and control groups shared a similar demographic profile, but chi square analysis demonstrated that both experimental groups had more women than men and more existing patients than new. While both experimental groups were mostly non-White, there were statistically significantly more African Americans in the control and more Hispanics in the intervention. Patients in the intervention condition were younger, and more likely to have public insurance. Patients at Clinic A were more likely to be older, African American and using public insurance.

Table 4 presents the prevalence of risk factors identified in the intervention group using the tablet based screening, compared to the prevalence rates determined by chart review among those in the control group. Using logistic regression analysis that controlled for clinical site, experimental group, gender, age and race, the intervention group had statistically significant higher detection rates for

every risk/medical condition when compared with the control group. Alcohol abuse was significantly higher in the intervention group than in the control group, but prevalence varied by site, with higher rates of risky drinking in the control group at Clinic A (4.6%), than in the intervention group for Clinic A (2.4%) or the control group for Clinic B (2.3%). Rates of risky drinking were significantly higher (8.2%) in the intervention group at Clinic B. Dental needs, obesity, depression, basic needs and PTSD were the most common risks identified in the intervention group, with prevalence rates ranging between 32 - 56%. By contrast, much lower levels of these same risks were identified in a review of charts among patients in the control group. The highest prevalence rates in controls were observed for obesity (21.5%) and smoking (15.4%). The most striking contrasts between intervention and control patients involved basic needs, PTSD, and dental needs, which were rarely if ever observed in the charts of control patients, but had a substantial prevalence among intervention patients. In addition, the risk of domestic violence was not observed in the chart review, but was detected in almost 5% of patients completing the tablet screening.

Further analysis revealed that the prevalence of obesity, depression, domestic violence and osteoporosis among intervention patients varied by race (Table 5). African American patients were most likely to be obese. Hispanic patients were most likely to be depressed, experience domestic violence and need osteoporosis screening.

The number of conditions for which each patient was identified as being at risk was dramatically different depending on experimental group (Table 6). Based on a review of their medical charts, the majority of patients (56.5%) in the control group had none of the risk factors assessed in this study. In contrast, only 4.2% of

patients in the intervention group did not screen positive for any of the assessed risks. The modal category among intervention patients was positive screening results for two risk factors (22.4%), and 53% of the intervention group screened positive for 3 or more risks or conditions.

Analysis of the clustering of risks among patients in the intervention group was done using the Fisher's Exact test to examine the association between each pair of binary screening variables. Table 7 presents the p-values resulting from these tests; to correct for multiple comparisons, the significance level was chosen to be 0.008, which controls for a false discovery rate of 5% (Benjamini & Hochberg, 1995). Thus, p-values less than 0.008 reflect statistically significant associations between pairs of risks. The results presented in Table 7 indicate a statistically significant amount of covariation among certain risk factors. These are depicted in Figure 2, where lines linking two risk factors or conditions reflect a statistically significant association after adjusting for multiple comparisons. The two conditions most commonly linked with other risks were PTSD and depression, both of which were associated with positive screens for BMI, smoking, and basic needs. Risk of domestic violence was also associated with basic needs, as well as risk for STI and alcohol abuse. Risks for falls, and need for further osteoporosis and colon cancer screening, and dental needs were not significantly associated with other risk factors or conditions.

Discussion

This study demonstrated that our use of mobile technology to screen patients in health center settings serving patients in the medical safety net enabled us to identify much higher rates of health conditions and social and demographic risks than are typically identified in clinical encounters and recorded in patients' records.

Patients who completed the risk screening were found to have rates that were significantly higher than those in the control group for every single risk factor/condition for which they were screened. Some conditions, like PTSD, were not identified at all in the control group, but were highly prevalent in the intervention group. For the majority of the risks and conditions we assessed, prevalence rates were several times higher among intervention patients compared to controls. The most common risk varied by race; White patients were most likely to be smokers, African Americans were most likely to have a BMI over 30, and Hispanics were most likely to be in need of dental care. The majority of control patients did not have evidence of any of these risks or conditions in the target visit. In contrast, over 95% of patients in the intervention group exhibited risk factors for one or more conditions, with a majority of those exhibiting between 1 and 4 risks. Behavioral health conditions co-occurred at high rates, and tended to occur with socioeconomic deficits such as food insecurity and basic needs risk.

There have been many targeted interventions to increase screening on singular risk dimensions in primary care, such as colon cancer screening or depression screening, universal risk screening strategies that deliver a comprehensive profile of the prevalence of the most common risks seen in an urban primary care setting have been uncommon. This study provides valuable insight into the needs of a traditionally underserved population in a comprehensive and holistic way, rather than “siloing” particular health risks. Most patients in urban and underserved settings arrive at their primary care visits with multiple complex health concerns that may not be illuminated in an appointment for chronic disease management (e.g. diabetes, hypertension, asthma, etc) or for an acute concern (e.g. ear infection, injury, etc.), but which still appreciably impact the global health of

patients, their adherence to treatment regimens, and their ultimate health outcomes, as well as influencing workforce productivity, educational opportunities, and overall community health (DHHS, 2010; Paul et al., 2013; Ward et al., 2014). Risks like basic needs, depression, and PTSD may not be the stated reason for the visit, and may not be identified during the visit, but may have a marked effect on patients' ability to adhere to treatment protocols, and are conditions that make the management of chronic disease more costly and complex if left untreated (Paul et al., 2013; Ward et al., 2014).

While all populations are in need of more effective, efficient screening strategies, populations in the medical safety net have more pressing and complex unmet needs, exaggerated by disparities in access to and quality of care, as well as poorer health outcomes. Though some issues of access have improved with the introduction of the ACA, the high deductibles associated with ACA insurance plans often exacerbate limits in access to appointments, medications and diagnostic tests (AHRQ, 2015a; L. Anderson et al., 2003; CDC, 2013). Adopting universal screening has the potential to reduce those disparities by identifying risk in an evidence-based, non-biased way for all patients. The identification of these areas of higher risk should improve outcomes for individual patients, but can also direct clinics to areas where preventive and care coordination strategies can be enacted to reduce overall disparity and improve outcomes. In order to identify quality, cost, and disability ramifications, these risk data can also help public health authorities map implications for cost and disease development along a predictive timeline,. These data also serve to create foundational arguments for appropriate funds to address the risks as identified in a preemptive mode, leading to cost savings, as well as improved

population health and improved economic, educational and quality of life outcomes for populations that have traditionally been at the margins.

This has particular implications for the way primary care in safety-net settings is delivered, as this setting presents complex and multifaceted risk profiles to providers. These risks include identifying factors that have previously been beyond the purview of the types of services delivered in primary care (e.g. basic needs like food insecurity or pre-homelessness or dental risk), and also identifying risks at much higher volume than clinics are used to addressing, both in the type of risk and in the volume of patients. A more concrete understanding of this population's health profile presents meaningful challenges to clinics, as patients with multiple risks require additional staff time, alteration of clinical workflow, referral resources, while presenting administrative and reimbursement challenges. This type of screening technology provides data that allow clinical leadership to advocate for increased or targeted funding and to create environments that better meet the needs of these patients. This would require allocating longer visit times for some patients, hiring staff to address particular needs in prevalence "hot spots" (such as community health workers and behavioral health professionals) and focusing staff and patient education around those needs.

There were several limitations to this study. Although every effort was made to identify validated measures to use in the screening questionnaire, there were some areas of risk (e.g. dental risk and basic needs) for which validated measures do not currently exist. In these cases, we developed measures based on focus group feedback from experts. Additionally, although BMI was included as an assessment of obesity, this is a controversial measure of health, and clinical sites reported that patients were, at times, unwilling or unable to accurately estimate their

weight and height. Because of this, we determined that this factor is better objectively measured by MAs rather than relying on self report. Additionally, there are substantial limitations on the ability of medical charts/EHRs to capture all elements of the clinical encounter; they therefore may underestimate risk factors identified and addressed in the visit.

In an era where more attention is being brought to care coordination, patient centered medical homes, and preventive services, screening technology such as the one used in this project capture data on multiple dimensions in a way that is efficient for clinics, accurate and timely for providers, and reflects patients' experiences and behaviors. This project presents one method for obtaining those risk data that might otherwise not emerge in a clinical visit, leveraging technology to increase efficiency, accuracy, and acceptability in a clinic setting. Having a more comprehensive picture of the health of patients, particularly for patients who have historically been underserved in healthcare, increases the likelihood that individuals will receive much-needed care and that overall health disparities will be identified and ameliorated.

CHAPTER FOUR: Using mHealth Technologies to Improve the Identification of Behavioral Health Problems in Urban Primary Care Settings

The purpose of this chapter is to compare screening results at Clinic B (n=146) to data derived from chart reviews in control group patients (n=129) to determine: 1) the rates of unrecognized and undiagnosed behavioral health problems in this patient population, and 2) whether increased recognition of behavioral problems in the encounter was associated with appropriate treatment and follow-up.

Results

Data sources are presented in Table 8. The demographic characteristics of participants are presented in Table 9. Overall, patients in the intervention and control groups were similar. A majority of patients were Hispanic. Two thirds of patients were female, with half of patients receiving Medicare or Medicaid and a quarter uninsured. Most had been patients in the clinic for longer than six months and had been seen by a clinic provider in the previous six months. Statistically significant differences in the age distribution of intervention and control patients were observed with chi-square analysis, with a greater proportion of younger patients in the intervention group. Demographic characteristics of patients seen in the clinic during the intervention period who did not complete the risk screening assessment are also presented in Table 9. Those who did and did not complete the screening during the intervention period shared a similar demographic profile with the exception of race, with African American patients making up a larger percentage of patients who were not screened compared with patients who were screened.

Table 10 contrasts rates of behavioral health problems identified during the target appointment through patient screening (intervention group) with those identified by providers during the clinical encounter and recorded in the patient's chart (control group) as a result of usual care. Using logistic regression analysis with age as a covariate (because it was the only statistically significant demographic difference between the two groups) indicates that much higher rates of behavioral health problems were identified through patient screening than were identified by providers during the encounter. Depression was over 5 times more likely to be identified among intervention as opposed to control patients (OR = 5.3, 95% CI = 2.5, 11.3). PTSD was unrecognized among patients in the control group, yet its prevalence in the intervention group exceeded 28% (OR = 105.6, 95% CI = 6.5, >999) and a Firth bias correction using a penalized likelihood estimation method was used to address separation issues (Firth, 1993). Alcohol abuse was 3.5 times more likely to be identified among intervention patients, but this difference was not statistically significant because the number of cases was so small. There was no statistically significant difference between the intervention and control groups in identification of behavioral health disorders in the six months prior to the target appointment.

Although patient screening resulted in much higher rates of identification of those with behavioral health problems, rates of documentation in patients' EHRs of identified behavioral health issues resulting from those visits and rates of follow up care remained very low. Screening results for one third of all patients in the intervention group were not entered into the patient records, probably due to time constraints. Among these patients, only one patient, who had screened positive for depression, had that finding noted, and none of these patients received any follow up

care. Table 11 presents rates of EHR documentation and follow-up care among the two-thirds of intervention patients whose screening results were entered into their medical records and reviewed by their provider. Among those screening positive for any of the three behavioral health disorders, few patients had their results included in the notes section of the EHR during the target appointment. Even fewer had their screening result recorded in the EHR problem list, or received follow up treatment. Among patients screening positive for depression, 39% had their screening results included in the notes section of the EHR during the target appointment, 9% had their screening result included in the problem list, and only 18% were provided any follow-up care. In contrast, patients screening positive for alcohol problems and PTSD were even less likely to have had their screening results included in either the EHR notes or list, and only 2 patients screening positive for PTSD received follow up care. It should be emphasized that these low rates of documentation and follow-up were observed despite the fact that the vast majority if not all of the cases identified through screening were “new” cases, i.e., were not previously reflected in the patient’s EHR.

Discussion

In this study we demonstrate that automated, tablet-based screenings using validated, patient reported outcomes are effective in identifying previously unrecognized illness in an urban, underserved population. The tablet-based protocol identified substantially higher levels of alcohol abuse, depression and PTSD in comparison to a group of patients treated previously in the same clinic, even though the clinic routinely used the PHQ-9 to screen for depression. To our knowledge, this is the first study demonstrating the effectiveness of electronic, patient-reported screening for identifying behavioral health problems in primary care settings.

This approach holds great potential for assisting clinicians in addressing the meaningful and often unrecognized behavioral health needs of patients that are typically seen in FQHCs and other safety net settings, as well as more affluent areas. However, our results also indicate that screening alone is not sufficient to ensure that patients receive adequate follow-up care, which is consistent the findings of previous research (Husky, Sheridan, McGuire, & Olfson, 2011; Miranda et al., 2013; Unützer & Park, 2012; M. Weissman et al., 2010). Even in a clinic routinely screening for, and addressing, behavioral health issues, newly identified behavioral health issues were not included in many patients' problem lists, a critical portion of the medical record for codifying and monitoring patient health (Liddy et al., 2011; Yawn & Wollan, 2005). Moreover, few of these patients were referred for treatment, despite on-site behavioral health specialists in this clinical setting.

When presented with these findings, providers and staff identified several issues that might prevent patients from being successfully referred to behavioral health services. Providers observed that it was challenging to make "warm hand offs" when clinic schedules were too busy or staffing was limited, or when the behavioral health provider was not immediately available. Providers also spoke about the challenge of talking with patients about "difficult" issues or finding language that "made sense" to patients, particularly if patients were members of a culture that particularly stigmatized these types of behavioral health issues or attributed their causes to factors outside of the patient (e.g. sin, evil, weak character, etc.) or if there was a language barrier. Several providers referred to resistance of patients to being identified with a behavioral health disorder, which included patients refusing additional follow up, saying they felt better after talking about it, had outside support, did not believe the screening results, or were embarrassed.

This study has several limitations. First, the small sample size of patients in a single clinical setting limits the generalizability of these findings, and we were only successful in screening 47% of the eligible patients. Second, while our intervention group was demographically comparable to control patients, we had limited information on patients who declined to use the electronic tablet screening and why. Clinic staff was responsible for asking patients to complete the screening questionnaire, and information on reasons for refusal was not systematically collected. Although this approach replicated the real-life workflow of the clinic, we cannot be sure that there are not some statistically significant demographic or health differences in patients who were not screened. Third, the use of the patient chart as a proxy for the content of the clinical encounter can be problematic, as it may not fully reflect the content of the clinical encounter (Liddy et al., 2011; Yawn & Wollan, 2005).

Although screening is a critical first step for identifying patients at risk, it alone is not sufficient to ensure adequate care. Recommendations to address the challenges to follow up are addressed more fully in Chapter Six. Future studies should seek to understand how such information could be integrated into a clinical workflow that supports clinicians in both recognizing and responding to the behavioral health needs of patients. A key element of successful screening interventions will be the integration of results into team-based function so that a team member is made accountable for reviewing, identifying unaddressed risks and acting on them. Such data could also be useful to teams in following behavioral health outcomes over time by yearly repetition of the screening. Despite its limitations, this study presents a promising approach to identifying previously unrecognized behavioral health problems in a challenging patient population and lays the

groundwork for future efforts to improve clinical outcomes. By collecting patient-reported outcome measures during patients' idle time in the waiting room, this approach addresses screening requirements in an efficient and pragmatic way and yields health information that is unlikely to be generated in a typical clinical encounter.

CHAPTER 5: Lessons Learned in the Implementation of mHealth Risk Assessment in an Urban Primary Care Environment

This paper reviews the process, successes, and challenges of implementing a tablet-based mHealth risk screening study in two community health center settings.

Results: Proposed Vs. Actual Intervention Process

The proposed screening process involved approaching every primary care patient presenting to the clinic when they registered at the front desk for their appointments. Patients would be given a tablet on which they could complete the screening questionnaire, with assistance from reception staff if necessary.

Screening results would then be tabulated automatically and presented as a risk screening profile that would be entered into the medical record and made accessible to providers during the clinical encounter, through a desktop icon.

Table 12 presents the contrast between the proposed screening process and deviations in that process as actually implemented at the two clinics. The two clinics in which this project was implemented represented vastly different urban primary care environments. Clinic A serves as a teaching and training clinic for large hospital and university systems, with interns and residents cycling regularly through the clinic rotations. Primary care services are offered, but ancillary services, like behavioral health or specialist care, are limited. Paper patient records were used, wireless connectivity was limited, and front desk staff and nursing staff were limited. While the staff was enthusiastic about the benefits of screening to their patients, the number of patients, reduced staffing due to budget constraints, a change in clinical leadership and limited time also overwhelmed them. In this clinic, patients were given the tablets to complete the screen, and the tablet was handed to a nurse or

MA after completion. Given frequent personnel turnover, the lack of an EHR, and overwhelmed staff, primary care providers did not reliably see the results of the screening, nor did they enter those results by hand into their paper charts. Over the course of 91 days of screening, 327 patients completed screening. Because of the disconnect between the scheduling and charting systems, it was impossible to determine who was an eligible patient at Clinic A.

Clinic B is a smaller community health center site with two providers, two MAs, a nurse and two front desk staff who were enthusiastic about the opportunity to use technology for patient screening and who felt that they could implement the project by working out a collaborative process. Primary care services were offered, with onsite behavioral health and dental care employing a “warm-handoff” method of referral in which the medical provider introduced the patient to the dentist or therapist to either make an appointment or be seen for immediate care. EHRs were also used in this technology rich and adequately staffed clinic, but the EHR could not be configured to accept data imports from the risk screening tablet. Patients were given the tablet in the waiting room, completed it with the help of front desk staff if needed, and handed the tablet to the MAs, who reviewed the results and entered them into the EHR for the provider to access during the appointment. Over the course of 32 screening days of the intervention, 146 patients (46.5%) out of 314 eligible patients completed the screening.

Discussion

Implementation of the screening protocol can be broken down into two process segments: screening patients and then addressing screening results so that patients benefit from them. This pilot project demonstrated success in the first segment of the process, although the data collection process was severely

hampered by lack of wireless connectivity and data interoperability in the systems, which are discussed below. These challenges meant that some patients who were eligible to complete the screen were not able to, that there were periods of days or weeks when tablets were not used, times when staff were frustrated or overburdened, all of which impeded the collection of valuable data and made it difficult to determine whether the goals of the project were met. In the course of the intervention, 473 patients were screened for a variety of chronic disease risks and conditions, many for the first time. Comparison to the control group demonstrated that the electronic risk-screening tool identified a substantially higher prevalence of health risks. The screening results are presented in Chapter 3, but positive screening results led to follow up care for more individuals in the intervention group than in the control group, illuminated new service needs, and contributed to a more complete health profile of the clinics' underserved, urban populations.

Prior to the implementation of the electronic screening intervention, several potential impediments were identified by focus groups with clinic staff and project leadership: 1) patients would not be able or willing to complete the screening assessment, 2) tablets would be lost or stolen, and 3) staff would not accept a new screening protocol. In fact, these concerns were unfounded. The majority of patients approached to complete the screening assessment participated and were able to complete the assessment in around 5-8 minutes. Additionally, not a single tablet from either clinic was lost or stolen. Staff members created a numbering system for keeping track of tablets (e.g. Mr. F has Tablet 4) and patients were responsible about returning the tablets to the medical staff, without a single incident of theft or attempted theft.

Challenges

The Technological Environment

The second segment of the screening process, management of results and follow up care, proved to be more challenging. The two clinics participating in this project differed markedly in their IT resources and infrastructure. Technology barriers were: 1) technology environment and culture, and 2) integration of systems, including EHR integration. Clinic A had limited wireless connectivity, limited onsite IT support, and no EHR. Clinic B had a sophisticated technological environment with IT support and an EHR. Both clinics presented different challenges to the implementation of electronic screening on tablets, for opposite reasons. Staff members at Clinic B felt comfortable using the tablet technology and helping patients use it. Because they were so used to sophisticated technology, they expected a high level of functionality and a fast-paced technological workflow. They were frustrated when there were the inevitable “glitches” or interruptions involved in introducing a new technology. Staff at Clinic A was unused to technology in the clinic environment, as their exposure to health IT was limited, and were comfortable using paper and hard copy for most aspects of clinical operations and charting. The introduction of an electronic tablet required a paradigm shift for them, and a shift in their skill sets, interactions with patients, and clinic processes.

The second barrier to smooth implementation of this technology was the clash between the clinical IT infrastructure (e.g., wireless connectivity, EHRs, scheduling software) and the portable tablets and screening software. While data were generated on the portable device, these data were stored on clinic servers, and Wi-Fi was required by the tablets to function. Both clinics had limited wireless networks of insufficient reliability to support the tablet technology. The improvement of these

networks was a low priority for IT because clinic functioning was based on a wired network and wireless malfunction did not impede other clinical processes.

Additionally, discrepancies in the interface of clinical and tablet software created repeated malfunctions in the communications between tablet devices and server/databases, leading to many days of tablets being unusable.

Challenges in the interface of technologies also affected the clinical workflow. In the proposed workflow, providers were instructed to log in to the risk-screening database via a computer desktop icon. In Clinic A, the desktop systems were old enough that their software was not compatible with the tablet screening software. Thus, it became impossible for providers to reliably log onto the risk screening profile for patients, and this process was eventually abandoned, making the data transmission to providers in Clinic A inoperable. For Clinic B, the technology barrier was caused by the difficulty and expense of integrating data generated by the tablets seamlessly into the EHR. This presented an issue in workflow for the staff of Clinic B, when the additional step of an MA entering screening results into the EHR became necessary, reducing efficiency and increasing frustration.

The “Now What” Problem

The clinical resources were different between the two research sites, but both staffs expressed concern about three issues once patients had completed the screening:

1. *Talking to patients about difficult subjects.* At the introduction of the risk-screening process, many providers expressed some apprehension about talking with clients about difficult topics like a patient’s experience of domestic violence, alcohol abuse, depression symptoms or financial difficulties. They reported that they sometimes felt ill prepared to discuss topics that were once

beyond the purview of a primary care visit (for example, food insecurity), but that they felt were crucial to patient health.

2. *Providing referrals based on patients' newly discovered risks.* Lack of referral resources for patients with limited financial or insurance options also proved to be a consistent source of frustration for providers. Clinic A, though part of a larger hospital system, had few resources for behavioral health referral that were available to their publically insured or uninsured patients without a long wait for an appointment. Clinic B had integrated behavioral health and some dental resources, which alleviated a major referral burden. However, there were few obvious resources to address problems like food insecurity or specialist referral. When staff at Clinic B was able to identify some community resources for patients, providers reported feeling better able to address the risks identified by the screening tool. Staff at both clinics also expressed frustration at often being unaware if patients had seen community providers and being unable to access information about the disposition of those referrals if the provider had not contacted them directly.
3. *Insufficient time during clinical visit.* Providers universally articulated the challenges of addressing multiple serious and perhaps chronic medical and psychosocial issues illuminated by the screening within a 15-minute appointment in which they must also address the presenting issue, like an ear infection or diabetes management.

Challenges in Staffing and Workflow

Workflow challenges constituted the third barrier to implementation related to: 1) who would do what and when, 2) staff turnover and learning curve, and 3) limited time. Research project staff worked with medical staff at both clinics to identify a

workflow for the implementation of screening process based on the differences in environment and staffing. Despite that, staff in both clinics were concerned about which groups of personnel would be responsible for which segments of the screening process and how patients and tablets would be “handed off” from one group to another, particularly if some segments of staff felt workflow in this project (and other areas of clinic work) to be inequitable. Their concerns about clinical resources, and the effect of limited resources, directly affected the implementation of the screening tool. Clinical providers at both sites were routinely double or triple booked for patient appointments and reported needing additional nursing support. Providers at both clinics reported that their patients were high need, with complex sets of problems, and that they didn’t have enough time to attend to these needs adequately. Both clinics also reported needing additional front desk resources, as existing staff felt overburdened by registering patients for appointments, taking phone calls, and attending to provider and patient requests, while also managing the tablet distribution and collection.

Clinic A experienced a reduction in overall staffing during the course of the implementation due to budget constraints, and then experienced a change of clinical leadership, both of which caused additional stress at all levels of the clinic staff. Additionally, Clinic A served as a teaching clinic with students rotating on a regular basis, resulting in a lack of consistent providers to train about the screening tool procedures.

Conclusion

This pilot project demonstrated that it is possible to implement an mHealth risk screening intervention with a medically underserved, urban population, with some caveats. Screening administration (segment one) was successful in both clinics,

despite very different clinical environments that share a common thread of serving urban, publicly insured patients. Given the barriers encountered during implementation, it could be argued that these types of technology-based interventions should not even be attempted in resource- or technology-poor environments. However, the two clinics in which this project was piloted are representative of urban community clinic environments, and we propose that this is where the neediest patients seek care and where health disparities are most likely. This makes the implementation of innovative technologies in screening, prevention, and chronic disease management and care coordination even more crucial. This pilot project identified technological barriers that can be addressed in future implementation in these settings (see below).

This project also demonstrated that electronic screening based on patient reported outcomes offers new information about patient risk for chronic diseases, information that is otherwise challenging to capture efficiently and effectively. This project proposes one method for providing comprehensive screening to meet USPTF guidelines in a non-biased and evidence-based way, with fewer screening burdens to providers and more patient involvement. Doing so will provide traditionally marginalized patients with more opportunity to receive preventive care or treatment for complex diseases, thus potentially addressing health disparities influenced by provider/staff attitudes or biases and differences in resource distribution.

While obtaining the screening data was the smoothest component of the project, getting that screening data into the exam room for use in the patient encounter proved to be challenging. Several anticipated barriers to the implementation of this project (stolen tablets or patients not knowing how/wanting to use tablets) turned out to be unfounded. Other barriers that we had either

inadequately prepared for or had not expected became difficult obstacles. Several recommendations have emerged as a result, and are discussed in more detail in Chapter Six: 1) Care pathways and clinic resources need to be developed for every risk dimension; 2) The technology used needs to be very stable and seamlessly integrated into existing clinical IT structures; 3) “Champion” staff members and pockets of resistance to the process need to be identified and addressed; 4) All levels and segments of clinic staffing need to participate in the development of an effective workflow; and 5) Nursing and nursing paraprofessionals can be empowered to act on the recommendations generated by this type of screening intervention via standing orders supervised by PCP staff.

Though this project was challenged by the rapid technological innovation and adoption that made some of the tablet technology and clinical IT systems incompatible, there is also a philosophical barrier between the mHealth and clinic technological systems. Health care IT has historically been oriented to protecting data, rather than facilitating access to data from external sources, for fear of vulnerability. Introduction of a new technological process in which portable mHealth devices (like tablets) must work with healthcare IT infrastructure or send to or receive data from IT infrastructure represent a growing challenge, particularly in clinical settings with disparities in access to technological innovation and support. As technology continues to be more integrated into clinical operations, and as primary care patients present with more complex chronic diseases and their sequelae (Hamine et al., 2015; Ward et al., 2014), screening methods that reduce staff time and effort, while leveraging the experience of patients, provide an opportunity for safety net primary care clinics to address the charge of preventive services for populations that have been traditionally underserved.

CHAPTER SIX: Conclusion

The overarching goal of this project was to develop and deploy an innovative technology platform to assess patient-reported risk factors with the aims of improving patient outcomes by making results available to clinicians at the point of the encounter. The three studies presented in this dissertation offer a number of key insights regarding the potential benefits of, and challenges associated with, the use of mobile health technologies to assess patient risk in clinical settings.

Previous efforts to screen patients in these settings have been much more limited in several respects. First, they have largely been focused on conditions like cardiovascular disease or diabetes for which clinically assessed disease markers are required. Second, they have typically focused on one or two risks or conditions and thus have not been capable of providing a comprehensive portrait of patient risk. Third, the methods employed to assess patient risk – typically paper and pencil questionnaires – have made it difficult to use the information collected in the clinical encounter. In this innovative project we addressed the weaknesses of previous studies by collecting self-reported data on patient health history, behavioral health, psychosocial risk factors, and health-risk behaviors in a comprehensive way using a tablet-based instrument that could be scored immediately and made available to primary care providers during a clinical visit and then offered to patients via a risk-report card with proposed evidence based actions consistent with existing clinical pathways at the clinical site. Our results offer new information about levels of risk in medically under-served, urban populations, challenges to follow up care for behavioral health conditions, and challenges and opportunities when implementing new technologies and screening protocols in safety-net settings.

One of the most important findings from this research involved the high levels of unrecognized and undiagnosed risks and conditions in this patient population. While many of the risk dimensions and medical or behavioral health conditions for which we screened have not had reliable prevalence rates in this population, the estimates we obtained by reviewing patients' medical charts grossly underestimated the level of risk. When compared with data from the chart review, screening results demonstrated that these patients have statistically significantly higher rates of risk on every dimension, with rates of depression (32.1%), PTSD (32.3%) and dental risk (55.6%) much higher than has previously been reported in the literature (Alegría et al., 2008; Alim et al., 2006; Ani et al., 2008; Montero et al., 2003). Most striking were findings involving PTSD, which was not observed in any of the charts of control patients but was observed in one third of patients completing the screening. Screening results also revealed that most patients were struggling with multiple risk factors: the vast majority of screened patients had two or more risks, a stark contrast to the results of the chart review which revealed the majority of patients as having zero risk factors. We also demonstrated that certain risk factors were statistically significantly associated with one another: depression with PTSD, and domestic violence with basic needs, which is consistent with syndemic theory of the excess burdens of co-morbid conditions (Singer & Clair, 2003). Understanding how risks are associated and clustered can increase provider efficiency and accuracy in identifying and anticipating risk. This screening tool yields a more comprehensive and reliable risk profile for patients served by the medical safety net and, by enabling providers to identify and treat comorbid conditions, has the potential to improve treatment outcomes.

This study also demonstrated, however, that screening for these conditions is necessary but insufficient to improve health outcomes. Identified rates of alcohol abuse, PTSD, and depression were statistically significantly higher in the intervention population compared with the control group, and the majority of those identified had not previously been identified with the condition. When intervention patients were identified with these conditions, rates of treatment in the form of follow-up appointments, prescription and referral, though higher than in the control group, remained relatively low. Even with the screening tool, 0 patients identified with alcohol abuse received follow up care, and only 18.2% of patients identified by screening with depression symptoms and 6.3% of those with PTSD received follow up care in the six months after the target appointment. This held true even though this clinic had access to integrated behavioral health care. This result spotlights some of the choke-points in the identification-treatment pathway where patients are “lost” or drop out and may indicate areas in which clinics must make strategic efforts to develop more robust clinical pathways or engage patients in care.

Challenges and Limitations

This project also illustrated the obstacles to implementing new processes into clinics, particularly those involving new information technologies, and revealed the scarcity of resources available to safety net practices to either address patients’ needs within the clinic or refer to specialty care. Ironically, what we worried about most in designing this intervention -- theft of tablets, minimal patient acceptance -- proved to be no challenge at all. In fact, patients were quite willing to contribute information about their symptoms, behaviors, and experiences in an effort to assist providers in delivering higher quality, more personalized care.

Still, the technological barriers to implementation considerably impacted the success of the project. As a result of these technological challenges, there were major discrepancies between the design of this project and its actual implementation. In practice, the technology interface in both clinics was not reliable enough to operate uninterrupted during the entire intervention period. This issue required continual changes to the intervention protocols impacting the identification of eligible patients, the continuity of screening periods, and the ability of providers to review results.

These challenges resulted in “mis-matched” processes and datasets between the clinical sites. In Clinic A, we collected a large volume of screening data, but had incomplete data on eligible patients for recruitment, and no chart review data for screened patients. Technology challenges also prevented providers from seeing screening results, which meant they were unable to identify and address risks in screened patients, although the aggregate data were helpful in enabling Clinic A to identify areas of need and in overall risk surveillance of their patients. In Clinic B, the interface between the wireless infrastructure in the clinic and the tablet technology made stability of the tablets unpredictable. As a result, some patients who could have been screened were not, and some results that should have been seen by the provider could not be entered into the EHR, while the MAs entered the remaining results into the EHR. These workflow and technology difficulties illuminated the challenges of clinics where demand is high and assets (time, staffing, technological infrastructure, referral resources) are low.

As a consequence of these and the other barriers discussed in Chapter Five, this project had several limitations, which included: use of some screening questions that lacked data on validity, limited samples of patients, lack of data on eligible

patients, and potential lack of generalizability to other safety net clinical environments. Risk dimensions selected for inclusion in the development of the screening questionnaire were determined by a combination of most common issues seen in this population and areas of risk of particular interest to the clinical leadership. While every effort was made to select validated instruments, there were some risk dimensions (like dental risk and basic needs) where a validated instrument did not exist. Instead, focus groups and counsel with experts in the field resulted in selection of screening questions determined to represent the state of the art for given risk dimensions.

There were also substantial difficulties in obtaining charts on all of the patients in the intervention condition. Given the paper medical records and the challenge in requesting the volume of charts for all intervention patients from Clinic A, the number of charts available for review for intervention patients was limited and produced a smaller sample size than expected for several of our groups. We were not able to analyze the follow up care received by patients after the screening at both sites. Some of the statistical tests we had proposed using to illuminate racial and ethnic, gender, and socioeconomic differences were limited in their power and not generalizable. This was further complicated by the low incidence of some of the risk dimensions (e.g. osteoporosis and fall risk).

Additionally, given difficulties in technology and workflow, we were unable to screen every patient who came into the clinics. By accessing scheduling data we estimated that approximately 50% of eligible patients seen during the intervention period at Clinic B were not screened; however we could not obtain estimates of eligible patients for Clinic A. We cannot, as a result, guarantee that there were not statistically significant differences between patients who were screened and those

who were not, although the patients we screened were demographically similar to the general demographic profiles of the clinics.

Finally, these two clinics may not represent typical safety net primary care setting in the United States, as they fell on opposite sides of a spectrum in terms of team based care, integration of services, and technological infrastructure. The profile of a typical safety net primary care center likely has some structural and staffing elements of both of our clinical sites. While we were successful in screening a large number of patients, both clinical sites had difficulty with the volume and complexity of the resources required to address patients' needs, given the lack of in-house, specialty, or community resources.

Implications

Our results have important implications for current trends in healthcare delivery in the US. The Patient Centered Medical Home (PCMH), the nation's fastest growing and most widely supported practice transformation model in primary care, aims to create a single place for individuals to receive care that is "what patients want it to be" by emphasizing comprehensive and coordinated medical care with higher quality and lower costs (NCQA, 2015; Rosenthal, 2008; The American College of Physicians, 2006; Williams, Jackson, & Powers, 2012). Technological screening platforms like the one described here can provide patient-reported outcomes data to inform targeted interventions and care coordination to improve health outcomes at both the individual and population level, which are key standards for Patient Centered Medical Home (PCMH) certification (Higgins & Green, 2011).

Yet, while this screening intervention was successful in identifying risk conditions in this population, it also illuminated some of the more complex aspects of identifying risk without identified resources to which to refer patients. Staff members

at both clinics understood USPTF guidelines on screening and were committed to delivering preventive care to patients, but also expressed discomfort at some of the ethical dilemmas of identifying risk factors for which there were insufficient referral or specialty resources that could support patients. Whether it was for dental services or depression treatment, universal screening projects of this kind expose the ethical and practical difficulties of identifying problems for which there are often limited or problematic solutions for patients in safety-net primary care (Betancourt et al., 2004; Braveman & Gruskin, 2003; Kokanovic et al., 2009; Spitzer, 2005; J. S. Weissman et al., 2005). Screening programs have potential to identify disparities and can help target key clinic resources over the long term, but can also lead to a sense of frustration for providers and disengagement for patients, as well as exposing clinics and providers to legal risk. In this project, establishing care pathways and identifying key community and clinic resources ameliorated some of these concerns, but the paucity of specialty care available to patients with public or limited insurance remains a substantial concern.

As this project creates a fuller profile of the complexity of patients seen in these types of safety net urban practices, and identifies needs beyond the clinic, it also illuminates the need to develop efficient and effective critical care pathways *within* the clinic, or associated with the clinic. In urban safety net primary care with scarce personnel and structural resources, preventive service delivery creates an even greater burden (Fiscella & Holt, 2007; Fiscella & Epstein, 2008; Partnership for Prevention, 2007), particularly for patients with multiple medical and behavioral health conditions (Gerteis J, Izrael D, Deitz D, LeRoy L, Ricciardi R, Miller T, Basu J, 2014; Ward et al., 2014). Using technologies and protocols developed during this project, screening results could assist interprofessional teams to address pressing

health issues that may not emerge during the clinical encounter. The provider team, and particularly the nursing or MA staff, caring for a particular patient could be empowered (using protocols and standing orders) to identify and constructively engage patients at risk of various conditions, with information suggesting clinical pathways, evidence based evaluation strategies and site specific resources (D. Anderson et al., 2012; Institute of Medicine, 2010). This would address patient needs without additional burden for physicians, while allowing other members of healthcare teams to work at the “top of their licenses” (NACNEP, 2012).

Tablet-based screening protocols also have potential to address some of the growing fragmentation and disruption in primary care. While the ACA has provided more Americans than ever with insurance, it is not clear that more people will enter into traditional relationships with a primary care practice or an individual provider. With a growing emphasis on non-traditional care environments, like urgent care centers and pharmacy-based clinics, the fragmentation of healthcare and challenges to patient-provider rapport are growing concerns. The largest pharmacies and retailers in the US have announced ambitious plans to provide basic healthcare services on-site (Diamond, 2014; Japsen, 2014; Redman, 2014). Due to concerns over their potential to foster further fragmentation of healthcare and a movement away from physician-led care teams that establish durable relationships with patients, both the American Academy of Pediatrics and the American Academy of Family Physicians have issued formal statements of opposition or non-endorsement (AAFP, 2014; AAP, 2014). For people in traditionally underserved populations, this is an even more important concern, as they are more likely to change residences often, live in institutionalized settings like prisons or supportive housing, and have various other disruptions in their healthcare relationships. Implementing electronic

screening is one method of leveling the playing field for patients that present as “New Patients” continually, by taking a snapshot of patients’ health risks that may be complicating other factors of their lives, both medically and psychosocially, and by creating an electronic record of care. These are concerns that might not be discussed in an urgent care visit for something like bronchitis, but might be crucial to connecting a patient to more supportive and holistic care.

Recommendations

Even given the limitations stated above, lessons learned in the course of this project represent the types of challenges and constraints that might be seen in a real-world attempt to implement universal screening, new mHealth technologies, or complex care management of patients with multiple chronic diseases. Several recommendations have emerged from this project:

- 1) Critical care pathways, complete with a list of resources and potential providers to whom to refer, need to be developed and made available to all providers at the outset of the implementation;
- 2) The technology used needs to be very stable and seamlessly integrated into existing clinical IT structures, so that tablets work reliably, wireless capacity is allocated for communication between tablets and screening database/repository, and screening results are presented to providers easily in seamless merge with EHR. Apparatus of data collection may include hardwired kiosk system, or accessibility from smart phones, computers, or patient portals;
- 3) “Champions,” staff members who are enthusiastic about the contributions of screening to the clinical enterprise, willing to be point persons for staff concerns and questions, and empowered to demand

adherence to screening protocols when clinic staff are “stressed” or overburdened, must be identified;

- 4) Nursing support staff or MAs may be the people best qualified to address the challenges posed by this type of intervention because of their primary role in preventive services, care coordination and patient contact. These staff members could be trained to review risks and determine next steps based on clinical guidelines and make referrals via standing orders, of which the primary care provider could be informed, and could countersign and intervene if necessary; and
- 5) Workflow processes should be established with representatives at all levels of clinic staff to adequately assess and address staffing shortfalls or “stress points”, especially so that these processes can be flexible in response to changing care environments.

Conclusion

In addition to its direct impact on patient care, innovative technologies and prevention projects such as this one have the potential for a much broader public health impact. Comprehensive risk data, like those collected in this project, can pinpoint unaddressed areas of risk that can then inform targeted interventions to improve health outcomes at both the individual and populations levels, which should lead to a further reduction in racial and socioeconomic health disparities.

Furthermore, if these types of screening interventions are administered recurrently, patients and populations could be tracked over time to monitor and assess changes in risk, health-promoting behaviors, and health outcomes. These data also serve to document and support best practices and innovative quality improvement initiatives in the treatment of chronic disease and behavioral health disorders in populations at

risk, while also meeting certification requirements from the Joint Commission and National Committee on Quality Assurance PCMH on data collection and risk surveillance.

This project demonstrates the need to obtain crucial information from patients, to give providers more holistic information about patients, to establish care pathways and standing orders to capitalize more efficiently on provider time at all levels, and to identify and develop resources within primary care environments and beyond to address the complex needs of patients in ways that are culturally responsive, quality-focused, efficient, and effective. These types of innovations will support an evolving healthcare system that relies more on technology, fosters a team-based approach, and coordinates complex care, all with the aim of improving the health of traditionally underserved and marginalized populations.

Chapter Two Tables and Figure

Table 1. Patient Demographics by Experimental Group and Clinics

	Clinic B		Clinic A		Control	Intervention	Control v. Intervention	Clinic A v Clinic B
	Control	Inter.	Control	Interv				
	N=129	N=146	N=131	N=327	N= 260	N=473	P value	P value
	%	%	%	%				
Gender							.38	.29
Male	31	35.6	43.5%	36.4	37.3	36.2		
Female	69	64.4	55.7	63.6	62.3	63.8		
Age							.00	.00
18-24	7.8	16.4	4.6	13.1	6.2	14.2		
25-29	4.7	12.3	5.4	8.3	5.1	9.5		
30-39	27.1	28.1	13.8	15.3	20.6	19.2		
40-49	24	17.8	22.3	22.6	23.3	21.1		
50-64	25.6	19.9	34.6	30.3	30.4	27.1		
65+	9.3	5.5	19.2	10.4	14.4	8.9		
Race/Ethnicity			N=65*		N=191*		.00	.00
White	33.3	24.7	13.1	11.3	23.6	15.4		
African American	11.6	13.7	66.2	55.7	30.4	42.5		
Hispanic/Latino	52.7	59.6	30.8	25.1	44.5	35.5		
Other	2.3	2.1	--	8.3	1.6	6.1		
Insurance			N=23*		N=152*	N=146*	.13	.00
Public	57.4	48	69.6	NA	59.2	47.9		
Private	14.7	24	30.4	NA	17.1	24		
Self-Pay	27.9	28		NA	23.7	28.1		
Patient Status							.43	.69
Existing	91.5	89	91.4	NA	91.4			
New	8.5	11	8.6	NA	8.6			

*These variables were not always recorded in paper chart reviews in Clinic A, and so these data were not available for all patients, and thus percentages are adjusted. Note: Significance is determined by chi-square analysis. Statistically significant p values are noted in bold italics

Table 2. Measures-Data Source Table

Experimental Group	<u>Clinic A</u>		<u>Clinic B</u>	
	Problem in 6 months Prior	Target Appointment	Problem in 6 months Prior	Target Appointment
Intervention	<u>n=327</u>		<u>n=146</u>	
	None	Screening Results only via screening database	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes in any appt in last six months • Follow-up care recommended 	<ul style="list-style-type: none"> • Screening Results via database • EHR <ul style="list-style-type: none"> ○ Screening results noted by MA • Follow-up care recommended
Control	<u>n=131</u>		<u>n=129</u>	
	<ul style="list-style-type: none"> • Paper Chart <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes in any appt in last six months ○ Follow-up care recommended 	<ul style="list-style-type: none"> • Paper Chart <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes ○ Follow-up care recommended 	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes in any appt in last six months • Follow-up care recommended 	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes • Follow-up care recommended

Table 3. Health Domains and Risk Screening Guidelines and Tools

Health Domain	Screening Name	Screening Questions	Reference
Alcohol	AUDIT-C	<ul style="list-style-type: none"> • Did you have a drink containing alcohol in the past year? • How often do you have a drink containing alcohol? • How many drinks containing alcohol do you have on a typical day of drinking? • How often do you have five or more drinks on one occasion? 	Bohn, M. J., Babor, T. F., & Kranzler, H. R., 1995; Garg, Butz, Dworkin, Lewis, & Serwint, 2009; Reinert & Allen, 2007
Basic Needs		<ul style="list-style-type: none"> • Do you and your family have enough healthy food to eat? • Do you have enough money to heat your home this winter? OR Thinking back to last winter, did you have enough money to heat your home? 	The Columbus House staff and clients, New Haven, CT; Bhat & East, 2015; Davila, Rajan, & Baron, 2006; Fiscella, Franks, Gold, & Clancy, 2000; Garg et al., 2009
Colonoscopy		<ul style="list-style-type: none"> • Are you behind in paying your rent or mortgage? • Have you had a colonoscopy in the last ten years? 	Emmons et al., 2009; Murff, Peterson, Greevy, Shrubsole, & Zheng, 2007; Pox et al., 2009
Demographics		<ul style="list-style-type: none"> • How old are you? • What is your gender? • What is your race? • What is your ethnicity? • Are you married or living with a partner? • Did you graduate from high school? 	
Dental		<ul style="list-style-type: none"> • Has it been longer than one year since you've seen a dentist? • Do you have any pain in your mouth? • Do your gums bleed when you brush your teeth? 	UCONN Health Center Dental faculty and students, Farmington, CT; Montero et al., 2003; Tang et al., 1997; U.S. Department of Health & Human Services, 2000
Depression	PHQ-9	<ul style="list-style-type: none"> • Over the last 2 weeks, how often have you been bothered by Little interest or pleasure in doing things • Over the last 2 weeks, how often have you been bothered by Feeling down, depressed, or hopeless 	Kroenke & Spitzer, 2002; Merz, Malcarne, Roesch, Riley, & Sadler, 2011

- Over the last 2 weeks, how often have you been bothered by Trouble falling or staying asleep, or sleeping too much
- Over the last 2 weeks, how often have you been bothered by Feeling tired or having little energy
- Over the last 2 weeks, how often have you been bothered by Poor appetite or overeating
- Over the last 2 weeks, how often have you been bothered by Feeling bad about yourself — or that you are a failure or
- Have let yourself or your family down
- Over the last 2 weeks, how often have you been bothered by Trouble concentrating on things, such as reading the
- Newspaper or watching television
- Over the last 2 weeks, how often have you been bothered by Moving or speaking so slowly that other people could have
- Noticed? Or the opposite — being so fidgety or restless
- That you have been moving around a lot more than usual
- Over the last 2 weeks, how often have you been bothered by Thoughts that you would be better off dead or of hurting
- Yourself in some way
- If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?
- How often does your partner: Physically hurt you
- How often does your partner: Insult or talk down to you
- How often does your partner: Threaten you with harm
- How often does your partner: Scream or curse at you

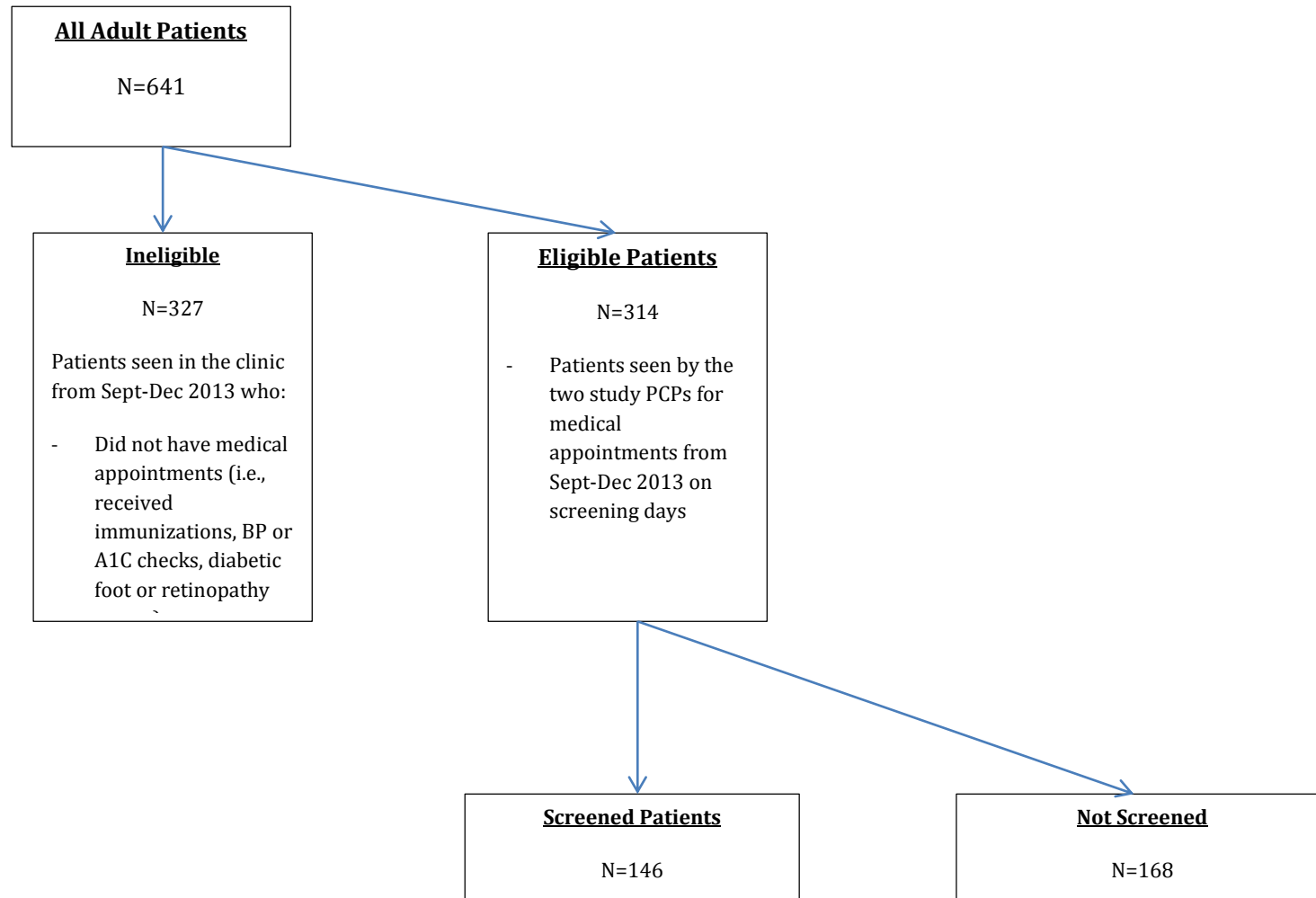
**Domestic
Violence**

HITS

Sherin, Sinacore, Li, Zitter, & Shakil, 1998

Falls		<ul style="list-style-type: none"> • Have you fallen in the last year? • Can you stand on one leg for longer than five seconds without support? 	Okumiya et al., 1998; Shumway-Cook, Brauer, & Woollacott, 2000; Shumway-Cook et al., 2009
General Health		<ul style="list-style-type: none"> • Overall, how would you rate your health? 	
Obesity	BMI	<ul style="list-style-type: none"> • How tall are you in feet and inches? • How much do you weigh in pounds? 	NIH, 2000; World Health Organization
Osteoporosis		<ul style="list-style-type: none"> • Women who are over 65 and White at particular Risk 	McLeod & Johnson, 2009
PTSD	My Mood Monitor	<ul style="list-style-type: none"> • Over the last 2 weeks, how often have you been bothered by nightmares or flashbacks • Over the last 2 weeks, how often have you been bothered by feeling jumpy or startled easily • Over the last 2 weeks, how often have you avoided places that strongly remind me of a bad experience • Over the last 2 weeks, how often have you been bothered by feeling dull, numb, or detached 	Gaynes. B., DeVeaugh-Geiss, J., Weir, S., Gu, H., MacPherson, C., Schulberg, H., Culpepper, L., & Rubinow, R., 2010
Sexual Health		<ul style="list-style-type: none"> • How many sexual partners have you had in the last year? • How often do you use condoms with your sexual partner(s) when NOT trying to get pregnant? 	American Academy of Family Physicians, 2009; American Academy of Family Physicians, 2015
Smoking		<ul style="list-style-type: none"> • Do you smoke? 	Agency for Healthcare Research and Quality, 2015

Figure 1. Flow Chart of Clinic B Patients during Study Period



Chapter Three Tables and Figure

Table 4. Frequencies of Risk Conditions

Condition	Clinic A		Clinic B		Totals		Control v. Sig.
	Control n= 131 %	Interv n= 327 %	Control n= 129 %	Interv n= 146 %	Control n=260 %	Interv n=473 %	
Alcohol	4.6	2.4	2.3	8.2	3.5	4.2	.000
Basic	2.3	47.7	1.6	39	1.9	45	.000
BMI	16	55.4	20.9	28.8	21.5	47.1	.000
Colonosc	6.9	20.8	5.4	9.6	6.2	17.3	.000
Depressio	13	33.3	7.8	29.5	10.4	32.1	.000
DV	0	4	0	6.2	0	4.7	.000
Falls	3.1	5.2	2.3	2.1	2.7	4.2	.000
Osteopor	0	0	.8	5.5	.4	1.7	.000
PTSD	0	34.3	0	28.1	0	32.3	.000
Smoking	9.2	30.9	21.7	28.1	15.4	30	.000
STI Risk	3.1	4.9	.8	1.4	1.5	3.8	.009
Dental	.8	53.8	1.6	59.6	1.2	55.6	.000

Note: Statistical significance of control vs. intervention patients determined using logistic regression models, controlling for site, condition, gender, age, race.

Table 5. Racial and Ethnic differences in prevalence of disorders in the intervention group

Disorder	White <u>n=73</u>	African <u>n=201</u>	Hispanic <u>n=168</u>	Other <u>n=29</u>	Sig. <u>p-value</u>
Alcohol	12.3	2.5	5.4	3.4	.08
Basic Needs	41.1	47.3	42.9	51.7	.67
BMI	35.6	57.7	41.7	0	.00
Colonoscopy	16.4	22.4	13.1	20.7	.06
Depression	35.6	25.4	39.3	34.5	.03
Dental	63	51.7	58.3	48.3	.29
DV	2.7	1.5	8.3	6.9	.01
Falls	4.1	5.5	2.4	10.3	.16
Osteo	2.7	0	4.2	0	.02
PTSD	30.1	27.9	37.6	37.9	.22
Smoking	42.5	28.4	26.2	31	.08
STI	6.8	6	3.6	3.4	.16

Note: Statistically significant differences determined by Chi-Square analysis are bold and italicized.

Table 6. Number of Medical Conditions identified per Patient

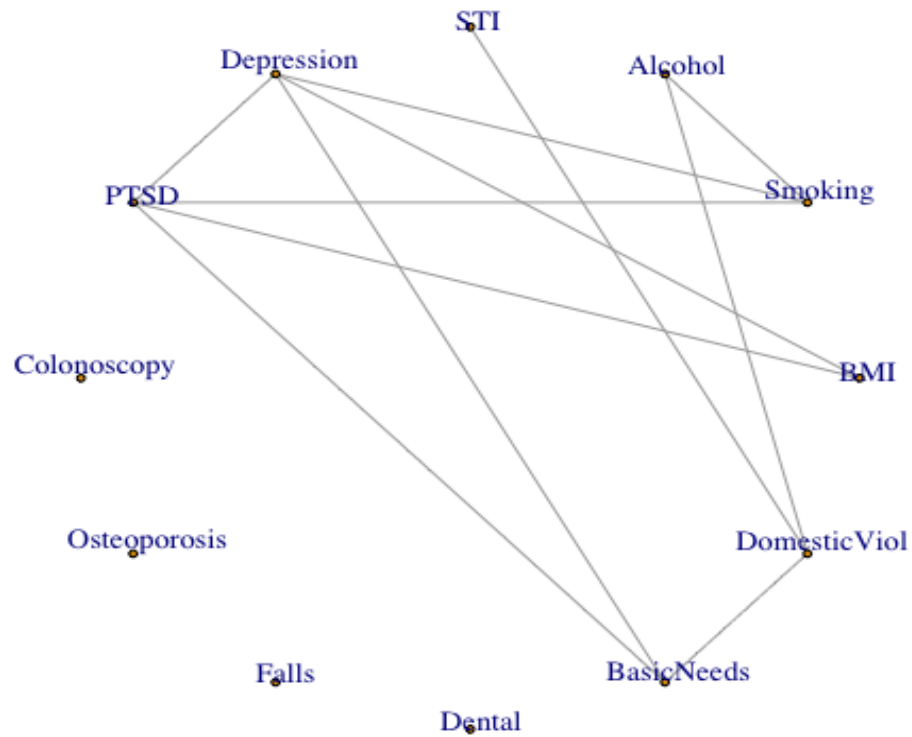
Number of Conditions	Control	Intervention
	n=260	n=473
0	56.5	4.2
1	27.3	20.7
2	11.9	22.4
3	3.5	17.5
4	.8	18.6
5	0	10.8
6	0	4.0
7	0	1.3
8	0	.2
9	0	0
10	0	.2

Table 7. Association between each Pair of Binary Screening Variables

	BMI	Smoking	Alcohol	STI	Depression	PTSD	Colonoscopy	Osteoporosis	Fall Risk	Dental	Basic Needs	Domestic Violence
BMI	NA	0.763	0.823	0.632	0.003	0.004	0.808	0.072	1	0.308	0.013	0.383
Smoking	0.763	NA	0.005	0.435	0.000	0.002	0.147	0.113	0.804	0.159	0.841	0.485
Alcohol	0.823	0.005	NA	0.035	0.226	0.228	0.224	1	0.586	0.251	0.178	0.001
STI	0.632	0.435	0.035	NA	0.304	0.306	0.336	1	0.547	0.469	0.47	0.007
Depression	0.003	0.000	0.226	0.304	NA	0.000	0.436	0.446	0.627	0.113	0.000	0.36
PTSD	0.004	0.002	0.228	0.306	0.000	NA	0.436	0.447	1	0.093	0.002	0.242
Colonoscopy	0.808	0.147	0.224	0.336	0.436	0.436	NA	0.034	0.062	0.113	0.903	0.396
Osteoporosis	0.072	0.113	1	1	0.446	0.447	0.034	NA	0.041	0.31	0.079	1
Fall Risk	1	0.804	0.586	0.547	0.627	1	0.062	0.041	NA	0.01	0.492	1
Dental	0.308	0.159	0.251	0.469	0.113	0.093	0.113	0.31	0.01	NA	0.926	1
Basic Needs	0.013	0.841	0.178	0.47	0.000	0.002	0.903	0.079	0.492	0.926	NA	0.003
Dom Violence	0.383	0.485	0.001	0.007	0.36	0.242	0.396	1	1	1	0.003	NA

Note: To adjust for multiple comparisons, the significance level was chosen to be 0.008, which control the false discovery rate at 5%. Statistically significant p-values less than 0.008 are shown in bold and italicized.

Figure 2. Statistically Significant Associations between Pairs of Two Risk Factors/Conditions in the Intervention Group



Note: Lines linking two risk factors or conditions reflect a statistically significant association after adjusting for multiple comparisons

Chapter Four Tables

Table 8. Measures-Data Sources Table for Behavioral Health Conditions (Clinic B)

Experimental Group	Problem in 6 months Prior	Target Appointment	Tx/FU 6 months following
Intervention	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes in any appt in last six months ○ Follow-up care recommended 	<ul style="list-style-type: none"> • Screening Results: <ul style="list-style-type: none"> ○ PHQ-9 ○ My Mood Monitor ○ AUDIT-C • EHR <ul style="list-style-type: none"> ○ Screening results noted by MA ○ Follow-up care recommended 	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in problem list or notes in any appointment in 6 months post target apt ○ Any mention of problem in problem list or notes in any appt in six months post
Control	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes in any appt in last six months ○ Follow-up care recommended 	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in Problem List or notes ○ Follow-up care recommended 	<ul style="list-style-type: none"> • EHR <ul style="list-style-type: none"> ○ Any mention of problem in problem list or notes in any appointment in 6 months post target apt ○ Any mention of problem in problem list or notes in any appt in six months post

Table 9. Patient Demographics by Experimental Group (Clinic B)

	Control n=129		Intervention n=146		Not Screened N=168		Intervention v. Control	Intervention Screened v. Not Screened
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>P-values</u>	<u>P-values</u>
Gender							.44	.75
Male	40	31	52	35.6	57	33.9		
Female	89	69	94	64.4	111	66.1		
Age							.05	.2
18-24	10	7.8	24	16.4	13	7.7		
25-29	6	4.7	18	12.3	22	13.1		
30-39	35	27.1	41	28.1	45	26.8		
40-49	31	24	26	17.8	35	20.1		
50-64	33	25.6	29	19.9	40	23.8		
65+	12	9.3	8	5.5	13	7.7		
Race/Ethnicity							.38	.04
White	43	33.3	36	24.7	26	17.3		
Af.-Amer.	15	11.6	20	13.7	35	20.8		
Hisp./Latino	68	52.7	87	59.6	97	57.7		
Other	3	2.3	3	2.1	10	6		
Insurance							.13	.19
Public	74	57.4	70	48	93	55.4		
Private	19	14.7	35	24	27	16		
Self-Pay	36	27.9	41	28	48	28.6		
Patient Status							.55	.38
New	118	8.5	16	11	24	14.3		
Existing	118	91.5	130	89	144	85.7		

Note. Significance determined by chi-square analysis. Statistically significant p-values are in bold italics.

Table 10. Prevalence of Behavioral Health Problems in Target Appointment and in 6 Months Prior to Target Appointment (Clinic B)

	Target Appointment			6 Months Prior		
	I	II	III	IV	V	VI
	Intervention	Control		Intervention	Control	
	(n=146)	(n=129)		(n=146)	(n=129)	
	% (n)	% (n)	OR (95% CI)	% (n)	% (n)	OR (95% CI)
Alcohol Abuse	8.2% (12)	2.3% (3)	3.50 (0.95, 12.92)	2.7% (4)	4.7% (6)	0.65 (0.17, 2.40)
Depression	29.5% (43)	7.8% (10)	5.33 (2.50, 11.33)	15.8% (23)	18.6% (24)	0.94 (0.49, 1.80)
PTSD	28.1% (41)	0	105.6 (6.48,>999)	2.1% (3)	0	7.47 (0.44, 128.4)

Note. Odds ratios and 95% confidence intervals were derived from logistic regression models with age as a covariate. Because of the lack of PTSD cases identified in the control group, logistic regression analyses were conducted using the Firth correction.

Table 11. Identification of Behavioral Health Problem and Follow up among those Identified with Behavioral Health Risks and whose Results were seen by Providers

Behavioral Health Problem	% Positive in Target Appointment (n=98)	% of those identified that were new cases	For those patients identified with the problem in the Target Appointment		
			<u>% in notes</u>	<u>% in list</u>	<u>% with follow up</u>
Alcohol Abuse	6.1% (6)	100% (6)	16.7% (1)	0	0
Depression	33.7% (33)	78.8%(26)	39.4% (13)	9.1% (3)	18.2% (6)
PTSD	32.7% (32)	96.9% (31)	12.5% (4)	6.3% (2)	6.3% (2)

Chapter Five Table

Table 12. Proposed vs. Implemented Screening Process

	Recruitment	Exclusions	Screening	Presentation to Provider	Medical Record	Clinical encounter
Proposed Process	Every patient who registers at front desk	None	Done independently in waiting room; told to ask reception if any questions	Provider accesses results via an icon located on the exam room computer desktop	Entered into medical record immediately	Provider reviews and discusses results with patient; provides recommendations for follow-up
Clinic A	Dependent on reception staffing, technology	Diabetic foot clinic; gynecology	Completed in waiting room	None	None	None
Clinic B	Dependent on MA staffing, technology issues	BP/A1C checks; vaccination; retinopathy	Completed in waiting room	Tablet given to MA prior to encounter	MA enters screening results in EHR	If results are in EHR, provider reviews with patient

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